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INTERVERTEBRAL CAGE DESIGNS

REFERENCE TO RELATED APPLICATION

This application claims priority from U.S. Provisional Patent Application Serial No. 60/420,616, filed October 23, 2002, the entire content of which is incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates generally to spinal implants and, in particular, to improved intervertebral cage designs.

BACKGROUND OF THE INVENTION

There are many intervertebral implants to assist with stabilization and fixation, including pre-assembled mesh rings of varying size; cylindrical threaded cages; carbon fiber boxes; and bone dowels, rings, and wedges. However, all existing devices have certain drawbacks, including the requirement of multiple steps and tools to prepare and mold the intervertebral plates for acceptance of the devices.

Existing implants also exhibit the need to remove/move a distraction device such as a spreader or plugs around a decorticate. Such plugs/distraction devices often get in the way of cage placement. Mesh cages in bone materials can deform or break with attempts to force them into the inner space. Typically, only a small surface of the end plate is exposed to bone graft, this being dictated by the size and position of the cage. Existing devices also require large trays with many instruments and many cages, and it is difficult to see the bone fused in mass inside metal cages, which are radiopaque.

SUMMARY OF THE INVENTION

This invention resides in cage systems that improve upon the prior art in various ways. In the preferred embodiments, devices are radiolucent, with markers, thereby

allowing visualization of placement without excessive obscuration. Devices according to the invention eliminate multiple steps, instruments and trays, while being capable of a custom fit. The devices according to the invention permit easier and greater access to end plate surface area, and can be used with autografts, allografts, and biologics.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a drawing that shows a preferred embodiment of the invention;

FIGURE 2 is a series of drawings which shows important instruments used to implant devices according to the invention;

FIGURE 3 is a drawing that shows how the shapes would preferably be varied for different vertebral levels;

FIGURE 4A shows how disc material is removed to determine the lateral extent of a disc space;

FIGURE 4B is a drawing that shows a disc space being dilated to a desired height using distracters which are preferably color coded;

FIGURE 4C shows a cage being inserted;

FIGURE 4D illustrates how, with the implant released and the introducer tool removed, easy access is available to the end plates;

FIGURE 4E shows how end plates are prepared, and grafting material, biologics, and so forth are packed in;

FIGURE 5A is a first view of an implant according to the invention;

FIGURE 5B is a second view of an implant according to the invention;

FIGURE 6A is a drawing that shows how a proximal guide sleeve is attached onto one vertical side wall of the cage and drilled and tapped as necessary;

FIGURE 6B shows a locking screw in position;

FIGURE 6C shows how a universal screw driver/holder is used to place distal screws into the cage;

FIGURE 6D depicts the lower aspect of a cage being locked into a distal vertebrae;

FIGURE 6E is a lateral view of a cage in place;

FIGURE 6F is an anterior-posterior (AP) view of a cage in place;

FIGURE 7A begins a series of drawings that depict an alternative embodiment of the invention including a different form of anterior fixation;

FIGURE 7B shows how a fixation jig is used to introduce a screw or similar device through the intervertebral body proximally into the superior cage walls

FIGURE 7C shows how inferior fixation is accomplished with a ratchet screwdriver/ holder to deliver a fastener through the inferior wall of the cage into the vertebral body

FIGURE 7D is a drawing that shows how the screw preferably angles out laterally;

FIGURE 7E depicts a fixed cage in place;

FIGURE 8A shows the anchoring screw being pushed;

FIGURE 8B shows the pins advanced;

FIGURE 8C shows the device in-situ;

FIGURE 9A shows the hinged contoured back wall with the inserter prior to use;

FIGURE 9B shows the back wall being straightened and the side walls being spaced apart;

FIGURE 10A illustrates a different embodiment involving a sliding lateral expandable cage with locking screws; and

FIGURE 10B shows an expanded condition with the locking screws being used to stabilize the structure at a desired level of expansion.

DETAILED DESCRIPTION OF THE INVENTION

A first preferred embodiment of the invention is depicted in Figure 1. This design includes an open-faced cage 102, which is constructed of carbon fiber or other radiolucent material but for small dot radiopaque markers (not shown). The device includes a contoured dome-shaped side walls 104, 104' with a flat trapezoidal undersurface. Separate cages and tools may be used for the L5-S1 levels with more

pronounced trapezoidal shapes. An indented back wall 110 is used to prevent neurocompression. The side walls preferably include a recessed face with nippled intents 112 and screw holes 114 to receive a locking screw 116. A closing face gate 120 is provided with non-slip nipples and locking screw holes as well.

In addition to the dome-shaped contours of the upper end plate, different shapes for the L5-S1 levels, and the indented back wall, the use of an open-face plate with gate and locking screw mechanism allows the device to be packed and closed in-situ, thereby effectively assembling the cage between the vertebrae. Note that although this design includes numerous features which are believed to be novel, they need not be used entirely in combination, but may be used separately or combined in subsets. The side view at the right in Figure 1 illustrates the optional use of sawtooth features 125 on the upper surface 130, which is preferably dome-shaped, and the lower surface 140, which is preferably flat.

Figure 2 is a series of drawings which shows the instruments used to implant devices according to the invention. Most or all are removably attached able to a ratchet handle 200. The set includes a screwdriver 202; contoured, wedge-shaped retractors 206, preferably including a color-coded raised centering mark or ridge 207; U-shaped introducers 208, preferably including retractable wings 209 to release a cage 210 using control 211; graft impactors 220 and gate holder 230 including a screw mechanism 232 used to capture and release a gate 240. The impactors 230 are generally 25 in length, and preferably come in different sizes, such as 0.8 cm at one end and 1-2cm at the other, 0.5 cm at one end and 1 cm or less at the other, and so forth.

Figure 3 shows how cage shapes would preferably be varied for different vertebral levels. In each case, the implants would preferably utilize some or all of the other geometries described herein, including a general U-shaped construction, crescent-shaped side walls, domed tops, indented back wall, carbon fiber or other radiolucent construction with markers, serrated or tooth-edged, end-plate surfaces, and so forth. The devices would also preferably include correspondingly sized anterior gates, also utilizing

carbon fiber or other radiolucent material, with non-slip nipples, locking screw holes and associated screws.

Figure 4 is a series of drawings which show a method involving an anterior approach to the intervertebral space. In Figure 4A, disc material is removed with tool 402 to determine the lateral extent of the space. In Figure 4B, the disc space is dilated to a desired height using distracters 206 which are preferably color coded. The final distracter is removed and replaced with the same color-coded implant introducer instrument 208, with the cage being inserted as shown in Figure 4C. The implant is released and the introducer tool removed, allowing easy access 410 to the end plates as shown in Figure 4D.

In Figure 4E, the end plates are prepared, and grafting material, biologics, and so forth are packed in. In Figure 4F, a correspondingly sized anterior gate is locked into position using the gate holder and locking screws and screwdriver, and the wound is closed. Figure 5 begins a series of drawings which shows an alternative embodiment of the invention which allows for an in-situ cage to act as a stand-alone radiolucent cage system. In addition to the instruments previously described, this embodiment utilizes proximal left/right guide sleeves, a drill and universal head screwdriver. In terms of the implant itself, proximal and distal screws are used in conjunction with an in-situ cage having a locking gate, in this case modified to accept proximal screws and guide inferior screws. Different views of the implant are shown in Figures 5A and 5B.

In terms of the operative procedure, the steps previously described involving cage insertion are followed. However, in this case, a proximal guide sleeve is attached onto one vertical side wall of the cage and drilled and tapped as necessary, as shown in Figure 6A. The locking screw is shown in place in Figure 6B. The universal screw driver/holder is used to place distal screws into the cage, as shown in Figure 6C, allowing the lower aspect of the cage to be locked into the distal vertebrae as shown in Figure 6D. Figure 6E is a lateral view of the cage in place, and Figure 6F is an A-P view.

Now turning to Figures 7 and higher, which depict yet a further alternative embodiment including a different form of anterior fixation. As shown in this case, a

fixation jig 700 is used to introduce a screw or similar device through the intervertebral body proximally into the superior cage walls, as shown in Figure 7B. Inferior fixation is accomplished with a ratchet screwdriver/holder 702 , which delivers the fastener through the inferior wall of the cage into the vertebral body as shown in Figure 7C. The screw preferably angles out laterally, as shown in Figure 7D, with the fixed cage in place in Figure 7E. Figure 8 is a series of drawings which shows internal fixation using an advancing screw to push a fixation pin into the cortical end plate. Figure 8A shows the anchoring screw 802 being pushed, Figure 8B shows the pins 804 advanced, and Figure 8C shows the device in-situ.

Figure 9 shows yet a different alternative embodiment of the invention in the form of a collapsing cage suitable for endoscopic placement. The cage is hinged enabling it to be laterally expandable with an expandable cage inserter. Figure 9A shows the hinged contoured back wall 902 with the inserter prior to use, and Figure 9B shows the back wall being straightened and the side walls being spaced apart. Figure 10 shows a different embodiment involving a sliding lateral expandable cage 10 with locking screws 12. Again, an expandable cage inserter is used to move the side walls apart from the condition in Figure 10A to the expanded condition in Figure 10B with the locking screw being used to stabilize the structure at a desired level of expansion.

I claim: